
Space Weather Technical Forecast

Issued on Wednesday, 03 May 2023 at 01:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of R1 Minor-R2 Moderate radio blackouts throughout. Very slight chance of R3 Strong radio blackouts. Slight chance of G1/Minor Storm conditions to start and end the period. Active electron fluence continuing to start.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours. There are currently nine numbered sunspot regions on the visible disc. The largest remains for now AR3288. Although the delta configuration in the intermediate portion of the group looks to be persisting, there appears to be some slight decay. Its position approaching the limb makes any changes increasingly hard to discern. AR3289 (Cai, Beta) faded slightly. AR3293 (Ehi, Beta-Delta) in northeast quadrant has shown some simplification in the intermediate region of the group, but maintains a small and well defined delta spot. A newly numbered large region rotating over the eastern limb, north of the ecliptic, AR3297 (Dho, Beta) appears to be a bipolar region with mature leader and trailer activity, however confidence in the analysis is very low given the regions position on the eastern limb and may change significantly in the coming days. There is another large but magnetically simpler region now numbered AR3294 (Hsx, Alpha) also rotating over the eastern limb. All other sunspots are simple and/or small regions at present.

There are a number of potentially eruptive filaments on the Earth-facing disc, however no new Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by ACE and DSCOVR at L1 have eased slowly from a peak around 510-530km/s early in the period, to slightly elevated levels more recently of around 480km/s. The density has generally been at below average levels, though has been more persistently below average since 02/1800 UTC. The total IMF, Bt, was weak below 6nT with the north-south component Bz varying between +6 nT and -6 nT. The phi angle has been mostly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) as measured at GOES16, has been at background levels throughout. High energy electron flux (greater than 2MeV) as measured at GOES16, has been at mostly High levels, peaking at 5380 pfu at 02/1730 UTC. The 24-hour integrated fluence was at Active levels, with a decreasing trend, 2.42e8 integrated pfu recorded at 03/0000 UTC.

Four-Day Space Weather Forecast Summary

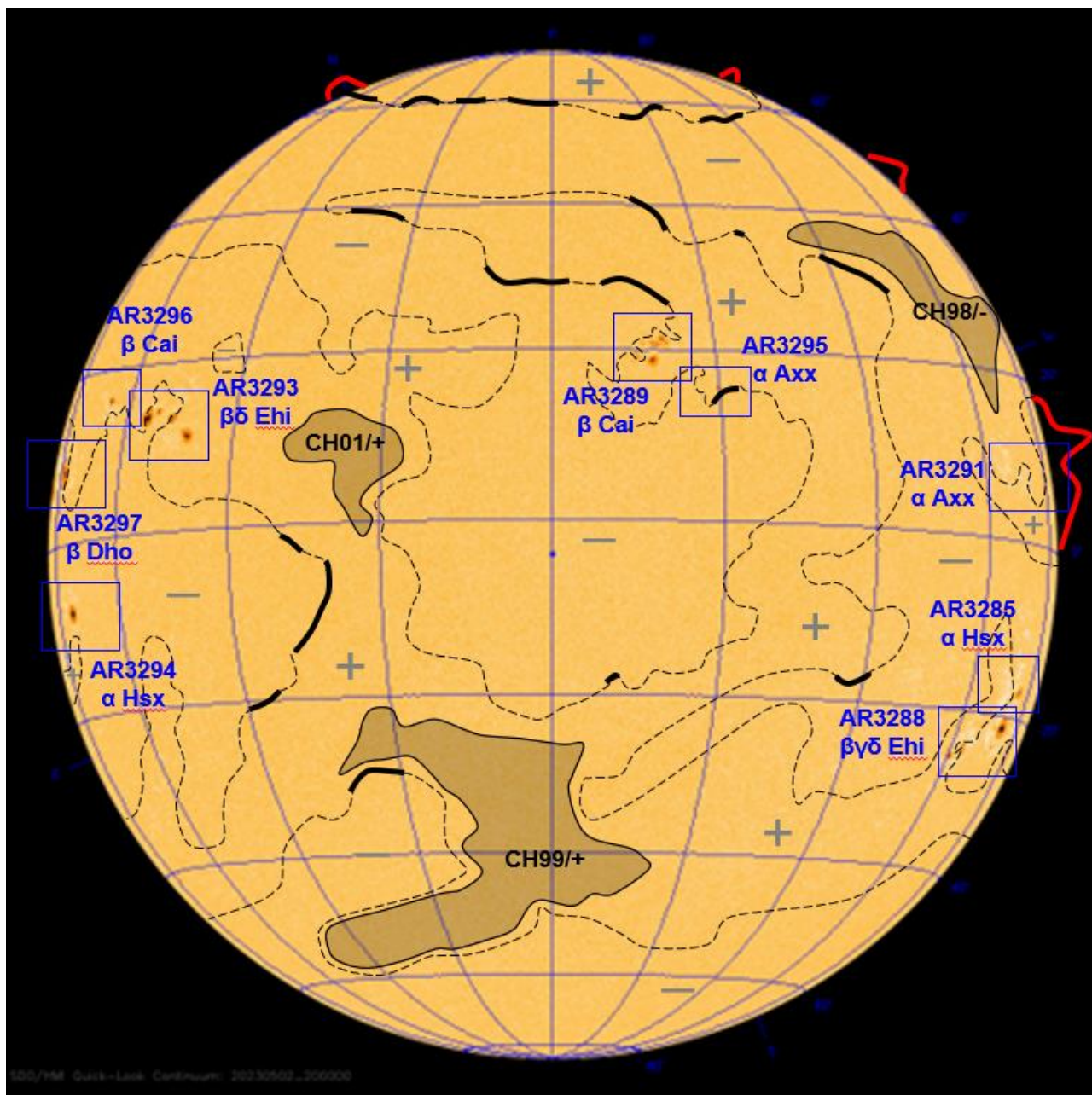
Solar Activity: Moderate to Low activity is expected with isolated M-flares (R1-R2 Radio blackouts) likely and a slight chance of becoming High from any isolated X-flares (R3 Radio blackouts).

Solar Wind / Geomagnetic Activity: There are several CMEs which are expected to largely miss Earth in the coming days, however some glancing influences cannot be ruled out. The most
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likely candidate CME to affect Earth left the Sun on the 29 Apr and is expected to pass by early Day 1 (3 May). Current slightly elevated wind conditions are expected to gradually ease towards background levels through the start of the period before the HSS associated with the non-recurrent CH99/+ in the southern hemisphere near centre-disc is anticipated to begin to affect Earth perhaps from late on Day 3 (5 May) but more likely into Day 4 (6 May). Geomagnetic activity is expected to be Quiet to Unsettled, but with a chance of Active intervals from any CME influence, most likely into Day 1 (3 May) and a slight chance of G1 Minor Storm intervals. Any influence from CH99/+ HSS also brings the chance of isolated Active intervals on Day 4 (6 May).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to persist at background levels. However count rates may increase with any significant flares that occur, with a slight chance of reaching the S1 Minor Radiation Storm threshold throughout. High energy (greater than 2MeV) electron flux is expected to continue to follow a generally diurnal cycle through the coming days, likely slowly reducing towards moderate or background levels, but with potential high levels at times of diurnal maxima. By day 3 and 4 (5-6 May) a return to Moderate to Background flux is thought likely with the increasing interacting of the HSS associated with CH99/+ helping to suppress electron activity. The associated 24 hour Electron fluence is currently above the Active level (1e8 integrated pfu) threshold and is likely to stay that way through the early period, but with an erratically decreasing trend.

Figure 1. Solar Analysis Valid 02/2000 UTC.



Key: Filament ___, Prominence ___, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

There have been numerous mainly faint filament eruptions resulting in observable CMEs over the past few days. These have been assessed as largely not Earth directed, however some weak glancing influences are possible through much of the period due to their proximity as they pass Earth. The most likely of these to give any noticeable impact is from a CME which left the sun early on 29 Apr from near AR3288. Any interaction from this is likely to be early in Day 1 (3 May) as it passes mostly to the south of Earth. A large asymmetric near full-halo CME evident in LASCO and STEREO-A imagery beginning around 02/0400 UTC has been assessed as far-sided and is not expected to affect Earth.

The current slightly elevated winds are expected to continue to slowly ease, declining erratically towards background speeds during Days 1 and 2 (3/4 May) in the absence of any glancing CME interaction. The HSS associated with the non-recurrent CH99/+ in the southern hemisphere near centre-disc is then anticipated to begin to affect Earth perhaps from late on Day 3 (5 May) but more likely into Day 4 (6 May). Likely impacts associated with the HSS are lower confidence as this is a new feature on this rotation, but are expected to be generally more muted given the positive nature and time of year, with ENLIL output currently suggesting winds to slightly elevated levels.

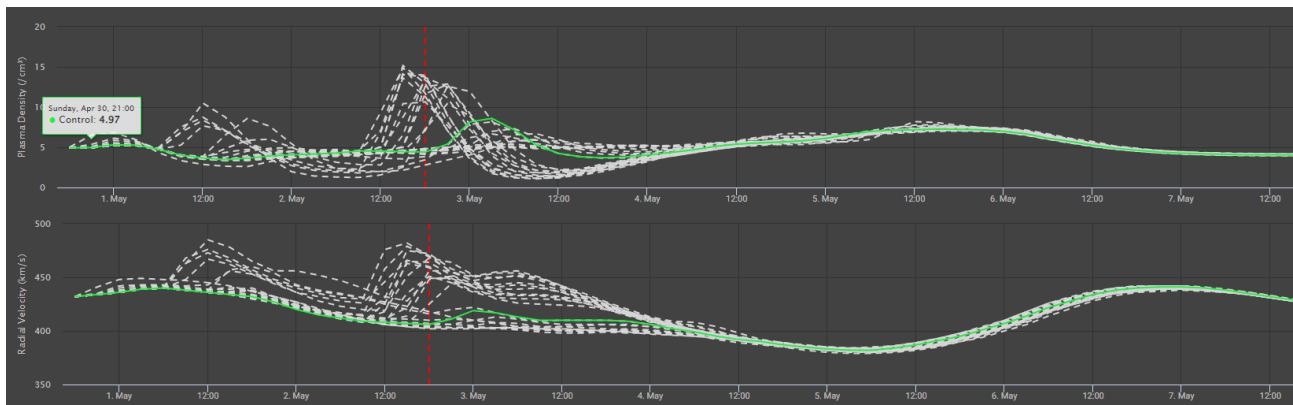
Geomagnetic activity is expected to be Quiet to Unsettled, but with a chance of Active intervals from any CME influence, most likely into Day 1 (3 May) and a slight chance of G1 Minor Storm intervals. Any influence from CH99/+ HSS also brings the chance of isolated Active intervals on Day 4 (6 May).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	5	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
29/1002	Partial	Filament eruption	S disk near AR3288	510 km/2	02/2200 UTC +/- 12 hrs	Glancing impact possible

Figure 2: Latest MOSWOC ENLIL output showing risk of CME glancing blow early in the period, though the risk of an earlier, stronger impact diminishing.



Radio Blackouts - X-Ray Flares:

Of the nine sunspot regions on the disc, three are currently considered the most likely source regions of more notable flaring. The first of these remains AR3288 (Ehi, Beta-Gamma-Delta) in the far southwest. This is a wide region consisting of a number of mature spots with strong umbra and symmetric penumbra, including a clear, albeit fading delta spot. The region is close to AR3285 (Hsx, Alpha), to its northwest which further complicates the magnetic looping of this region. Both regions will rotate over the western limb through Days 1 and 2 (3-4 May). AR3293 (Ehi, Beta-Delta) in northeast quadrant has shown some simplification in the intermediate region of the group, but remains a large region with a small and well defined delta spot, and frequent low level flaring observed during the past 24 hours.

A newly numbered region rotating over the eastern limb, north of the ecliptic, AR3297 (Dho, Beta) also presents an increasing risk of flare activity in the coming days. It appears to be a large bipolar region with mature leader and trailer activity, however confidence in the analysis is very low given the regions position on the eastern limb and may change significantly in the coming days. This region is thought likely to be ex-3273 from the previous rotation. There is another large but magnetically simpler region now numbered AR3294 (Hsx, Alpha) also rotating over the eastern limb.

Moderate to Low activity is expected with isolated M-flares (R1-R2 Radio blackouts) likely and a slight chance of becoming High from any isolated X-flares (R3 Radio blackouts). Flare probabilities maintained through the period as sunspot groups due to rotate off the disc are counteracted by the new regions emerging in the far east.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	55	55	55	55
Very Active	R3 to R5 X Class	No	10	10	10	10

Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux as observed by GOES-16 is forecast to remain at background, with no solar radiation storms expected. Any significant flares have the potential to increase the observed flux towards the S1 Minor radiation storm threshold, with a slight chance of activity maintained through the period.

Radiation Storms	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	10	10	10	10
Very Active	$\geq \text{S3}$ *	No	1	1	1	1
* S3 $\geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)						

High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy (greater than 2MeV) electron flux as observed by GOES-16 at GEO is expected to continue to follow a generally diurnal cycle through the coming days, likely slowly reducing towards moderate or background levels, but with potential high levels at times of diurnal maxima. Any glancing CME arrivals have the potential to suppress the observed flux further if they occur. However, these are generally expected to miss Earth. By day 3 and 4 (5-6 May) a return to Moderate to Background flux is thought likely with the increasing interacting of the HSS associated with CH99/+ in the southern hemisphere helping to suppress electron activity.

Electron fluence is currently above the Active ($1\text{e}8$ integrated pfu) threshold and is likely to stay that way through the early period, but with an erratically decreasing trend. Confidence reduces day 3 (5 May) onward, due to uncertainties about how quickly peak flux values will decay, along with the potential for any CME glancing blows and the approach of CH99/+. REFM model output supports a declining trend, however this is currently considered potentially somewhat too quick with its decline.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	Yes	100	80	50	30
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 3: Latest MOSWOC REFM output showing general declining trend.

